



## *Supplement of*

# **Application and validation of long-range terrestrial laser scanning to monitor the mass balance of very small glaciers in the Swiss Alps**

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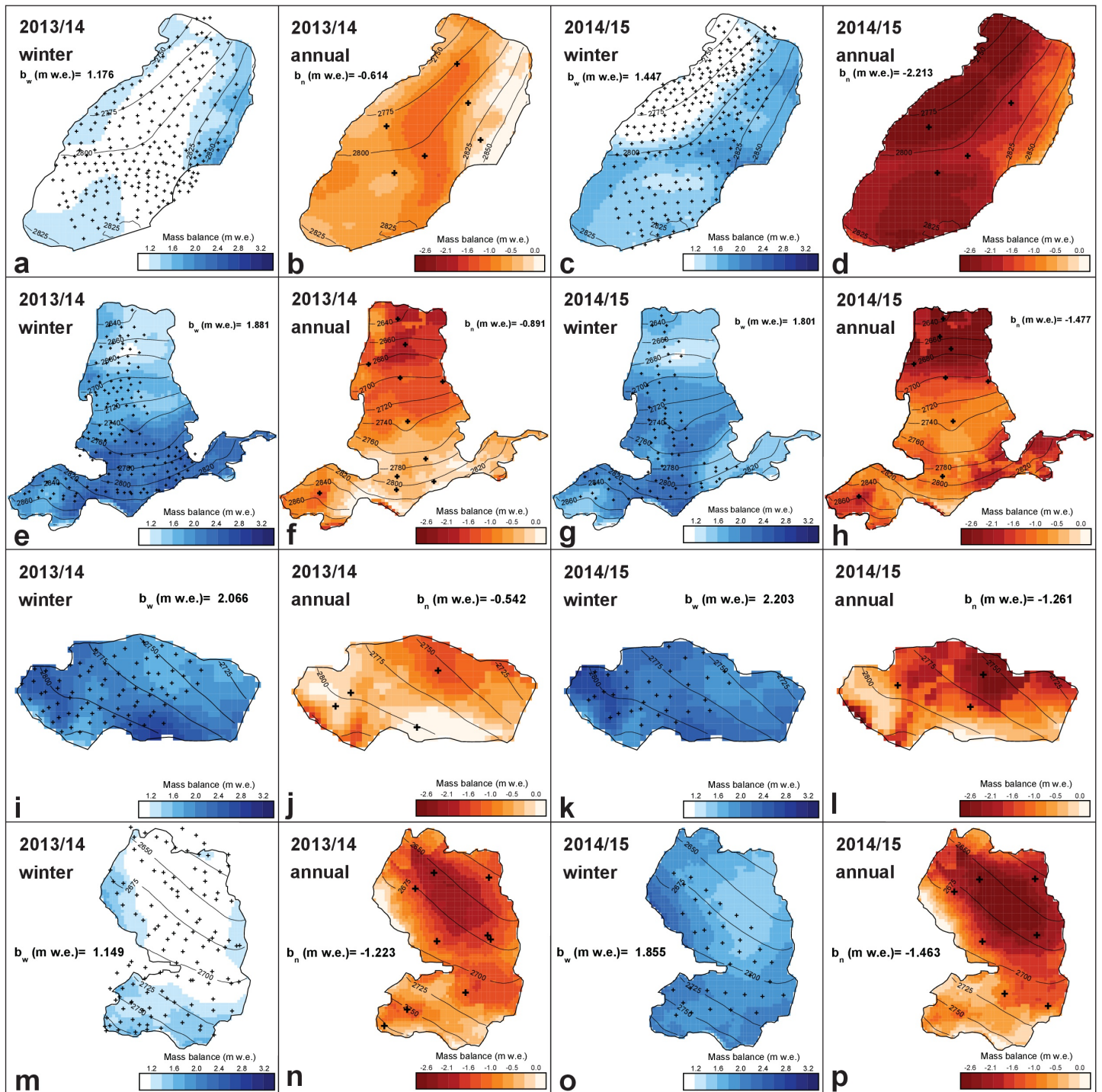
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**Supplementary Table S1.** TLS survey parameters for the individual surveys of Glacier de Prapio (PRA), Glacier du Sex Rouge (SER), St. Annafirm (STA), Schwarzbachfirm (SWZ), and Pizolgletscher (PZL).

Date	Surface area scanned m <sup>2</sup>	Number of points measured	Point density m <sup>-2</sup>	Total measurement time min
PRA				
14.09.2013	1085207	1036512	0.955	4
22.09.2014	824338	30573624	37.089	21
21.09.2015	1102932	28267120	25.629	20
SER				
14.09.2013	1554719	1405526	0.904	6
22.09.2014	1281187	29516688	23.039	24
21.09.2015	1309371	58373504	44.581	37
STA				
06.09.2013	780497	8245020	10.564	7
26.09.2014	901390	29901956	33.173	21
28.09.2015	1160962	77473844	66.732	54
SWZ				
07.09.2013	259828	601234	2.314	2
26.09.2014	273159	20420736	74.758	17
28.09.2015	290835	27396352	94.199	24
PZL				
23.09.2013	148557	2350828	15.824	3
20.09.2014	295283	2148581	7.276	2
09.09.2015	989954	20752611	20.963	22

**Supplementary Table S2.** Dates, number ( $n$ ), and spatial density of winter and summer glaciological mass balance measurements on Glacier du Sex Rouge (SER), St. Annafirn (STA), Schwarzbachfirn (SWZ) and Pizolgletscher (PZL).  $n$  refers to snow probings (winter survey) and ablation stake or accumulation pit measurements (summer survey).

year	Winter survey			Summer survey		
	Date	$n$	density ( $\text{km}^{-2}$ )	Date	$n$	density ( $\text{km}^{-2}$ )
SER						
2012	03.04.	21	78	24.09.	1	4
2013	23.04.	138	510	14.09.	5	19
2014	17.04.	224	828	22.09.	6	22
2015	22.04.	245	906	20.09.	4	15
STA						
2012	12.04.	31	143	03.10.	4	18
2013	13.03.	41	189	02.10.	10	46
2014	10.04.	153	705	23.09.	11	51
2015	15.04.	80	369	28.09.	9	47
SWZ						
2013	14.04.	60	1026	07.09.	2	34
2014	11.04.	76	1299	24.09.	4	68
2015	15.04.	31	530	28.09.	3	60
PZL						
2006	14.04.	61	689	13.09.	–	–
2007	02.04.	86	972	03.09.	2	23
2008	02.04.	43	486	25.09.	4	45
2009	07.04.	91	1028	13.09.	6	68
2010	02.04.	111	1254	22.09.	9	102
2011	26.04.	102	1153	24.09.	8	90
2012	30.04.	38	429	21.09.	8	90
2013	29.04.	119	1345	23.09.	9	102
2014	31.04.	118	1333	20.09.	9	135
2015	11.05.	50	565	27.09.	7	105



**Supplementary Figure S1.** Spatial distribution of direct glaciological annual and winter balance of (a-d) Glacier du Sex Rouge, (e-h) St. Annafirn, (i-l) Schwarzbachfirn, and (m-p) Pizolgletscher in 2013/14 and 2014/15 (measured periods, coinciding with start and end of LiDAR surveys). Cross symbols indicate the location of snow probes (winter) and mass balance measurements at stakes or firn pits (annual).